Nutrition and ESRD

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Outline

- Overview of Malnutrition in ESRD
- Physiology of Malnutrition
- Nutritional Assessment
- Nutritional Management

Epidemiology

- Estimates of “malnourishment” in dialysis varies. One range is 8-37%. Upper limits of various studies range 40-67%.
- National Cooperative Dialysis Study (1978-1980): 25% of ESRD patients were below the 5th percentile in muscle mass. 13% of men, 25% of women below 5th percentile in fat stores.

Epidemiology (cont.)

- 30% of ESRD population are at less than ideal body weight.
- >40% of patients have hypoalbuminemia.
- USRDS (1996): cachexia causes 1.9 deaths per 1000 dialysis patient-years.

NCDS Study (1978-1980)

- First attempt to elucidate correlation between nutrition and outcome.
- No difference between nPCR and mortality between the groups.
- Could not separate effects of nutrition from those of Kt/V.
- Patient demographics have changed considerably since then.

Outcomes Analyses

- No studies have been performed to directly determine the morbidity and mortality of malnutrition.
- No studies have been done which demonstrate benefit of nutritional interventions on outcomes.

"Malnutrition Syndrome" in ESRD

- ESRD patients develop a state similar to chronic malnourishment.
- This state does not appear to be corrected simply by adequate dialysis.
- Evidenced by alterations in anthropometry, serum proteins, amino acid profile.
- Malnutrition and uremia have synergistic effect on lymphocyte function

Etiologies of Malnutrition in ESRD

- Decreased intake: anorexia, loss of tast acuity, gastroparesis, medications dietary restrictions, depression.
- Intercurrent illnesses
- Nutritional losses during dialysis: missed meals, water-soluble vitamins, amino acids (4-10 gms/HD treatment. 5-15 gms/day on PD), glucose

Etiologies of Malnutrition in ESRD (cont.)

- Increased catabolism during dialysis
- Metabolic derangements of uremia
- Abnormalities in endocrine function

Serum Amino Acids in ESRD

- Essential amino acid concentrations are decreased overall.
- Inessential amino acid concentrations are increased overall.
- Improving protein intake does not correct all of the abnormalities.

Lipid metabolism in ESRD

- Renal failure may reduce clearance of VLDL, leading to higher triglyceride levels.
- Insulin resistance also contributes to hypertriglyceridemia.

Carbohydrate metabolism in ESRD

- RF is associated with fasting hyperglycemia and glucose intolerance.
- Proposed mechanisms: insulin inactivation, insulin resistance, inhibition of glycolysis.

Hemodialysis-induced catabolism

- Dialysis membranes cause increased protein catabolism. May also have membrane-independent component.
- Proposed mechanisms: release of proteases and free radicals by neutrophils, release of interleukins from monocytes.
- Degree of membrane bio-incompatibility may be important.

Serum Albumin and Mortality

- Lowrie and Lew (1990): prospecitve analysis death rate in 12,099 dialysis patients during 1988.
- Serum albumin < 4 g/dL was lab value more highly correlated with mortality.
- Risk ratio ranged from 2.21 for albumin between 3.51-4.0 to 7.45 for albumin less than 2.5.

Serum Albumin and Mortality (cont.)

Serum Albumin and Mortality (cont.)

- Owen (1998): albumin and other measures of nutrition may be markers for comorbid illnesses and not independent predictors.
  - Association to cardiovascular risk
  - Effect on serum levels by intravascular dilution, systemic inflammation

Nutritional Assessment in ESRD

- Recommended at dialysis initiation and q 3-6 months
- History and Physical Examination
  - Symptoms: taste acuity, gastroparesis, singultus, nausea/vomiting, anorexia, weight change
  - medications
  - psychosocial issues

Nutritional Assessment in ESRD (cont.)

- Dietary History
  - Should be performed by dietician
  - 3- to 5- day history recommended
  - Weighing of food increases accuracy
  - Fat, protein, carbohydrate, and energy intake can be calculated from standardized tables

Nutritional Assessment in ESRD (cont.)

- Anthropometric measurements
  - Based on standardized tables for US population (nonuremic vs. uremic)
  - RF manifested in reduced skinfold thickness (fat) and arm muscle area (muscle)
- Protein stores: albumin, creatinine, prealbumin, transferrin, retinol-binding protein

Nutritional Assessment in ESRD (cont.)

- Other serum chemistries: cholesterol, amino acids, BUN.
- Summary: no one parameter is valid. A panel or profile of values should be developed and followed.

Criteria for Malnutrition (Wolfson, 1997)

- Albumin < 4.0 g/dL
- decrease in EDW
- nPCR < 0.8 g/kg/day
- low Cr and BUN without residual renal function
- decrease in anthropometrics
- IGF-1 < 300 μg/L
- low predialysis serum K and phos
- prealbumin < 30 mg/dL
- Tchol < 150 md/dL
- Transferrin < 150 mg/dL

Nutritional Assessment in ESRD (cont.)

- High-Tech Tools
  - Bioelectrical impedance (BEI): total body water
  - hydrodensitometry: adipose tissue
  - Dual X-ray absorptiometry (DEXA): measures bone, adipose, and fat-free tissue
  - MRI: measurement of adipose
  - neutron activation analysis: total body nitrogen

nPCR

- UNA= Urea nitrogen appearance. Measure of the total nitrogen per day removed from body (excreted + dialyzed).
- nPCR = PNA = “protein equivalent of nitrogen appearance”.
- In steady-state, in = out and nPCR = UNA. UNA then provides a measure of protein intake.

nPCR and Kt/V

- Increasing Kt/V may increase nPCR as a mathematical artifice.
- Debatable that increasing Kt/V results in an increase in albumin or in dietary protein intake.

Recommended Nutritional Goals

- Caloric intake of 35 kcal/kg IBW
- 1.0-1.2 g/kg protein of high biological value for HD
- 1.2 g/kg protein for PD

Nutritional Management in ESRD

- Enteral supplementation is estimated to be in use in 15-35% of dialysis population.
- Several small studies report improvement in markers.
- No studies to document outcomes.

Nutritional Management in ESRD (cont.)

- Historical Perspective
  - 1940s
    - Protein-free calories: Balls of butter, starch-cream, potato-egg, rice-fruit-sugar. “Poor patient acceptance.”
    - 1948: parenteral glucose administration
    - 1949: G tube administration of peanut oil and glucose

Nutritional Management in ESRD (cont.)

- 1950-1970s
  - oral essential amino acids
  - 1969: intravenous EAAs
  - TPN, PPN
- 1980s
  - IDPN, IP

Nutritional Management in ESRD (cont.)

- Mild malnutrition: optimize eating environment, diet liberalization, calorie-dense food, oral homemade supplements.
- Moderate: commercial supplements, intradialytic parenteral nutrition (IDPN), intraperitoneal nutrition (IP).
- Severe: tube feedings (n.g., o.g., enterostomy), TPN, IDPN, IP.

Experimental Therapies

- Appetite stimulants: paucity of data. One study evaluating use of megastrol acetate is underway.
- rhGH
  - increases utilization of essential Aas
  - improves nitrogen balance, decreases BUN/nPCR
- IGF-1

Vitamins

- Water-soluble vitamins are lost during dialysis and must be replaced.
- ? Increased folate requirements with hyperhomocysteinemia.
- Fat soluble vitamins (A, D, K) not affected by dialysis. A and K replacement not required.
- Zinc replacement may improve dysguesia and impotence.

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